Independent Oversight Review of Electrical System Configuration Management, Safety Instrumented System Commercial Grade Dedication, Setpoint Calculations, and Software Testing at the Savannah River Site, Waste Solidification Building Project

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Office of Safety and Emergency Management Evaluations
Office of Enforcement and Oversight
Office of Health, Safety and Security
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Acronyms

CGD	Commercial Grade Dedication
CLI	Component Location Identifier
CRAD	Criteria, Review, and Approach Document
DATR	Design Authority Technical Review Report
DSA	Documented Safety Analysis
EEC	Environmental Evaluation Checklist
FAT	Factory Acceptance Test
HAW	High-Activity Waste
HSS	Office of Health, Safety and Security
LAW	Low-Activity Waste
NA-266	NNSA WSB Integrated Project Division
OFI	Opportunity for Improvement
PDSA	Preliminary Documented Safety Analysis
PSBCR	Preliminary Safety Basis Change Request
P&ID	Piping and Instrumentation Drawings
RICP	Receipt Inspection Criteria Package
SIF	Safety Instrumented Function
SIS	Safety Instrumented System
SRNS	Savannah River Nuclear Solutions
SRS	Savannah River Site
UPS	Uninterruptable Power Supply
USQD	Un-reviewed Safety Question Determination
WSB	Waste Solidification Building

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1.0 PURPOSE

The Office of Enforcement and Oversight (Independent Oversight), which is within the Office of Health, Safety and Security (HSS), conducted an independent review of selected aspects of the Savannah River Nuclear Solutions (SRNS), Waste Solidification Building (WSB) Project. The purpose of these reviews was to assess the adequacy of the contractor's follow-up to previously identified opportunities for improvement, and to provide feedback to the WSB Project design engineers on the adequacy of their processes and products for calculating Safety Instrumented System (SIS) setpoints and developing SIS software testing procedures.

The independent review was conducted during the periods April 23-26 and May 3-5, 2012, by Independent Oversight in coordination with the U.S. Department of Energy and the National Nuclear Security Administration, NA-266, WSB Integrated Project Division.

2.0 SCOPE

The HSS independent review examined the WSB Projects response to two HSS 2011 reviews, which focused on:

- WSB electrical system configuration management and change control
- Plans for commercial grade dedication (CGD) of the WSB SIS safety-significant components at the Savannah River Site (SRS).

HSS also reviewed the WSB Project processes for:

- Determining SIS setpoints
- Testing of SIS software.

The SIS safety function requirements, safety interlock design configuration, and safety-significant component critical characteristics were determined through review of selected sections of the WSB consolidated hazards analysis process, WSB preliminary documented safety analysis (PDSA), facility description document, "Process Control System" system description document, WSB safety requirements specifications, WSB SIS hardware procurement specifications, WSB SIS requirements specification for software, component product data sheets, and SIS logic diagrams and piping and instrumentation drawings.

Section 4.0 of this report describes the methodology used to perform this HSS independent review, while section 5.0 describes the review results. Section 5.0 is also organized in four parts to individually address the results of the reviews of the status of the two HSS 2011 report opportunities for improvement (OFIs) and the two selected new aspects of the SIS. Appendix A provides supplemental information about the review. Appendix B lists the documents reviewed. Finally, Appendix C identifies the remaining OFIs in CGD plans for individual WSB SIS components that were first identified in an HSS 2011 review, but have not been effectively addressed.

3.0 BACKGROUND

WSB is a hazard category 2 nuclear facility and a low hazard chemical facility currently under construction at SRS. The mission of the WSB is to treat specific high- and low-activity liquid waste streams from the SRS Mixed Oxide Fuel Fabrication Facility. WSB is designed to accept and process the liquid waste streams into solid waste forms acceptable for shipment and disposal as transuranic waste, low-level waste, or a liquid waste form that can be further treated at the SRS Effluent Treatment Project.

The WSB design includes a safety-significant SIS to provide active, reliable engineered controls to prevent or mitigate safety-significant events to acceptable levels of risk. The SIS is designed as a stand-alone, independent system to monitor and control safety-significant process and support systems, with sufficient redundancy to meet the availability/reliability requirements for a safety-significant system. SRNS has issued the procurement for the SIS to a commercial vendor (Emerson) and intends to apply CGD to the safety-significant components. SRNS has completed the final safety requirements specifications; receipt inspection criteria packages (RICPs); and technical evaluations, which address identification of critical characteristics, acceptance methods, and criteria.

The SRNS plans for CGD of the safety class high-activity waste (HAW) evaporator high temperature interlock (which is not part of the SIS) were not within the scope of this review.

4.0 METHODOLOGY

The HSS review assessed the adequacy of the SRNS responses to HSS 2011 OFIs for WSB Project's programs for safety significant electrical system configuration management and change control and for CGD of the WSB SIS safety-significant components. The 2011 OFIs had been previously identified using HSS CRAD 64-11, *Essential Systems Functionality*, and HSS CRAD 45-12, *Nuclear Safety Component and Services Procurement Inspection Criteria, Inspection Activities, and Lines of Inquiry*. The HSS review of WSB Project's programs for development of SIS setpoints and software testing were based on engineering judgment of the adequacy of implementation of the *ISA-RP67.04.02-2010, Methodologies for the Determination of Setpoints for Nuclear Safety Related Instrumentation, Quality Assurance Manual 1Q, Quality Assurance Requirements for Commercial Grade Items and Services, Procedure 7-3, Rev. 10, Quality Assurance Manual 1Q, Software Quality Assurance, Procedure 20-1, Rev. 13, and B-SQP-F-00034, Rev 5a, Waste Solidification Building Software Quality Assurance Plan.*

5.0 RESULTS

The results are organized to correspond to the scope of the HSS independent review, which addressed two HSS 2011 reviews and the two selected new aspects of SIS.

<u>May 2011 WSB Electrical Configuration Control Assessment Report</u>

The WSB Project response to the May 2011 WSB Electrical Configuration Control Assessment Report was reviewed for adequacy. Three of the four identified opportunities for improvement (OFIs) were adequately resolved. Specifically:

- The Desktop Instruction for Completion of the Design Authority Technical Review Report (DATR) was revised to change the proposed narrative for DATR Section 2.4 to reflect a more comprehensive narrative justifying what was done in place of an un-reviewed safety question determination (USQD). In the absence of an approved safety basis, the justification documents a review that is essentially equivalent to that required for a USQD or screen.

- The WSB Project Configuration Management Plan was revised to encompass the capability of design change packages to change technical baseline documents, particularly when used as required where the modification impacts multiple systems.
- A previous preliminary safety basis change request (PSBCR) was revised to establish consistency between the various sections of the PDSA that reflect the change in the standby diesel generator procurement specifications.

However, **t**he WSB Project has not yet determined how to address the HSS May 2011 OFI that the Desktop Instruction for completion of DATR Section 2.2 does not provide guidance regarding the need for completion of an Environmental Evaluation Checklist (EEC) when the DATR author does not believe an EEC is needed despite potential environmental impacts. An interview of the WSB Project representative responsible for determining the need to revise the DATR Desktop Instruction indicated that the DATR author may be aware of other information that voided the need for an EEC; however, DATR Section 2.2 still requires completion of an EEC when the design has the potential to create an environmental impact; e.g., when the type of fuel for a diesel generator is changed.

June/July 2011 WSB Commercial Grade Dedication Plans for the Safety Instrumented System

The WSB Project response to the *June/July 2011 WSB Commercial Grade Dedication Plans for the Safety Instrumented System* was reviewed for adequacy. The majority of the HSS 2011 identified OFIs with the DRAFT CGD plans have been appropriately resolved. A list of remaining 2011 OFIs with clarification where necessary is documented in Appendix C to this report. (See OFI-1.)

Essentially, all hardware acceptance test instructions, which are Attachment 1 to each Safety Requirements Specifications report, were revised to provide clear documentation of which component was tested to ensure component CGD traceability by component location identifiers (CLIs). However, component specific CLIs are not always practical, such as for individual fuses and fuse holders.

OBSERVATION: Use of the CLI may not be appropriate for maintaining CGD documentation traceability in some cases, such as for multiple individual small components. Other mechanisms for maintaining traceability to specific CGD activity documentation have not yet been established to cover such cases.

SIS Instrumentation Uncertainties Evaluation and Set Point Determination

A detailed review of an example of a draft SIS Instrumentation Uncertainties Evaluation and Set Point Determination calculation was performed to develop and provide feedback to the design engineers on the adequacy of their approach for developing and approving safety-class and safety-significant SIS setpoints. The DRAFT *J-CLC-F-00365_B, Instrumentation Uncertainties Evaluation and Set Point Determination-HAW [high-activity waste] & LAW [low-activity waste] Evaporator Steam Coil High Pressure Interlock* calculation was selected for review, because it was recently drafted and appears to be generally representative of other SIS setpoint calculations, such as the safety-significant WSB LAW Evaporator High Temperature Interlock.

The documentation of the safety-significant HAW & LAW Evaporator Steam Coil High Pressure Interlock instrument loop uncertainty and interlock setpoint calculation was excellent and generally met the guidance contained in *ISA-RP67.04.02-2010, Methodologies for the Determination of Setpoints for Nuclear Safety Related Instrumentation.*

NOTEWORTHY PRACTICE: Use of ISA-RP67.04.02-2010 provides an excellent format for accurately developing, documenting, and justifying setpoint calculations that facilitates completeness, review, and approval.

The method specified in supplied vendor documentation for determining pressure transmitter reference accuracy is not clear (i.e., assuming the value of the transmitter's upper range limit divided by the value of its designed span is equal to 50, which formula or value should be used in determining the pressure transmitter reference accuracy). Although the effect on the calculation of instrument loop uncertainty in this particular application would be small, the appropriate transmitter reference accuracy must be used in determining instrument loop uncertainty. Further, the assumed accuracy with which the digital displays can be read is not clear from the supplied vendor documentation in all cases. The uncertainty with which the gages can be read affects instrument loop calibration uncertainty and therefore can impact setpoint conservatism. (See OFI-2.)

OBSERVATION: The calculations for determining setpoints needs to be reviewed and reconciled with the safety bases once final safety limits are approved.

SIS Software Testing Plans

The SIS application software is being written by SRNS staff and will be tested in different phases to verify that all of the software requirements have been met. The first phase of the software testing will be conducted in a laboratory environment with simulated inputs and outputs. Although the simulator is fairly restrictive as to what can and cannot be simulated, each software module will be tested as fully as possible in the lab environment to functionally check the software prior to loading it on the actual SIS controllers in the field. After the software is loaded on all of the SIS controllers, additional tests will be conducted in the field with all units tied together as a part of the start-up test plans.

A detailed review of an example draft SIS software simulator test procedure was performed to develop and provide feedback to the design engineers on the adequacy of their approach for developing and approving similar software test plans. The simulator test procedure for the WSB LAW evaporator steam supply isolation valve interlocks was selected for review because it was recently drafted and appears to be generally representative of other SIS test procedures, such as the safety-significant WSB HAW Evaporator High Steam Pressure Interlock.

WSB Project staff indicated that it is an SRS established practice (H-Canyon documented safety analysis or DSA) to limit the evaporator temperature to 130°C (the red oil reaction initiation temperature limit) and the evaporator steam heating coil pressure to 25 psig to prevent the evaporator contents from exceeding 137°C (the red oil autocatalytic temperature limit). In similar fashion to H-Canyon, the steam pressure limit will be established in the WSB DSA and technical safety requirements. Instrument uncertainty calculations will establish an additional margin in the setting.

J-ESR-F-00027, Rev. 1, Waste Solidification Building Safety Requirements Specification, outlines the safety instrumented functions (SIFs) of the safety-class and safety-significant components of the SIS. The WSB LAW evaporator temperature and pressure interlocks are safety-significant components of the SIS designed to trip shut the evaporator steam supply isolation valves to prevent the evaporator contents from reaching a temperature that could support a runaway red oil reaction. The specification indicates that the SIFs for the LAW evaporator temperature and pressure interlocks that are software dependent include:

- Trip steam isolation valve solenoids closed to prevent the evaporator steam coil pressure from exceeding 25 psig.

- Trip steam isolation valve solenoids closed to prevent the evaporator contents from exceeding 130°C.
- Gross failure of any component in the system would not impact the integrity of the safety function.
- Failure of uninterruptable power supply (UPS) power would de-energize the discrete outputs from the logic solver, triggering the interlock and leaving the system in a safe state.
- Failure of either transmitter (pressure or temperature) would trigger an interlock in the safety-significant logic solver, causing the outputs to de-energize, leaving the system in a safe state. Failure of the DeltaV SIS logic solver would de-energize outputs, leaving the system in a safe state.
- Isolation valves are programmed to close if "bad" status is received from either temperature or pressure signal transmitter.
- Solenoid valves that supply air to open the steam isolation valves when energized cannot be opened unless process conditions are acceptable, regardless of the state of the reset switch pushbutton.

B-RS-F-00029, Rev. 0, Waste Solidification Building Safety Instrumented System Requirements Specification for Software, appropriately defines the SIS software design requirements that must be met for the control logic and Human System Interface configurations, and is intended to serve as the SIS software requirements baseline. The specification identifies each software logic requirement, acceptance criteria, verification method, and, where appropriate, significant additional observable information. Verification methods include documentation review, offline functional testing (factory acceptance test - FAT), and online functional testing (site acceptance testing). The identified software logic design requirements that must be tested and verified acceptable were appropriately derived from the SIFs defined in the *Waste Solidification Building Safety Requirements Specification* discussed above.

B-TPR-F-00119, Rev 0, Draft_3, Installation and Operational Verification of Low Activity Waste Steam Valve Module Test Procedure, was reviewed in detail against SRS Site, WSB Project, and SIS design requirements. The reviewed software test procedure is one of 36 that are in various stages of development, review, and approval. The reviewed procedure was developed as a FAT and utilizes simulated SIS hardware and input/output values. Additionally, the reviewed procedure is limited to testing the temperature and pressure interlocks, the inability to energize the steam isolation valve solenoids until the trip condition is cleared, that the steam isolation valve solenoids will not energize automatically when the trip condition is cleared, that temperature and pressure transmitter malfunctions will cause the solenoid vales to be tripped, and that expected information will be displayed to control operators. All setpoints and ranges were preliminary and must be reconciled with safety requirements and verified during start-up testing. The procedure appropriately defines the sequence of steps, step instructions, expected results, and how each step maps to the software logic design testing requirements of the *Waste Solidification Building Safety Instrumented System Requirements Specification for Software*. The procedure also requires a determination of pass/fail and identification of errors encountered for each procedure step. No conditions require the suspension of testing since this test will be performed in a simulated environment. Review and approval of the completed software test procedure is required prior to loading the software onto the field hardware. Site acceptance testing procedures have not yet been developed. Because the reviewed procedure was a draft, the following two items are characterized as observations.

Quality Assurance Manual 1Q, Software Quality Assurance, Procedure 20-1, Rev. 13, and *B-SQP-F-00034, Rev 5a, Waste Solidification Building Software Quality Assurance Plan*, requires that the Software Test Plan must demonstrate whether the SIS software and simulated hardware:

- Adequately and correctly perform all intended functions
- Properly handle abnormal conditions and events as well as credible failures

- Does not perform adverse unintended or unexpected functions
- Does not degrade the system either by itself, or in combination with other functions or configuration items.

The reviewed software test procedure appears to meet the first two criteria. However, the limited intent of the *Installation and Operational Verification of Low Activity Waste Steam Valve Module Test Procedure* and its design as a simulated FAT prevent meeting the last criteria. Further, the reviewed test procedure fails to demonstrate that the software does not perform adverse unintended or unexpected functions. For example, the test procedure requires demonstration that the temperature and pressure interlocks trip with an injection of a 90-percent signal, but does not demonstrate the interlocks don't trip at some lower injected signal level. The WSB Project staff indicated that additional software tests will be performed beyond the start-up tests to ensure that all software requirements are met.

OBSERVATION: The SIS site acceptance testing plan must be designed to verify the software does not degrade the system either by itself, or in combination with other functions or configuration items once the software is loaded into the SIS hardware,

OBSERVATION: Subsequent software/hardware test procedures must be designed to demonstrate that the software does not perform any adverse unintended or unexpected functions.

The RESET push button is designed with momentary contacts. As such, the simulation of the software's response to depression of a RESET pushbutton by forcing an input of "1" into a SIS RESET port that is not immediately forced to "0" appears to be inappropriate. For example, see *Installation and Operational Verification of Low Activity Waste Steam Valve Module Test Procedure* step 23 followed by step 30. Many other examples of this potential test procedure deficiency were also identified (steps 33, 43, 45, 64, and 66). The WSB Project staff indicated that momentary contact nature of the pushbuttons cannot be simulated in the lab with the Emerson simulator. However, they do intend to verify the adequacy of response of the SIS software to pressing the SIS Reset buttons following installation of the software on the SIS hardware during site acceptance testing. (See OFI-3.)

6.0 CONCLUSIONS

Three of four opportunities for improvement identified in the HSS *May 2011 WSB Electrical Configuration Control Assessment Report* have been appropriately resolved. The WSB Project staff has not yet determined what additional guidance is needed for completing the DATR form when the author of the report does not believe an EEC is needed despite potential environmental impacts.

The majority of concerns identified in the HSS *June/July 2011 WSB Commercial Grade Dedication Plans for the Safety Instrumented System* have been appropriately resolved. Appendix C to this report lists and clarifies the remaining SIS component CGD plan OFIs identified in 2011 that merit additional effort for resolution.

A detailed review of an example of a draft SIS Instrumentation Uncertainties Evaluation and Set Point Determination calculation was performed to develop and provide feedback to the WSB Project design engineers on the adequacy of their approach for developing and approving safety-class and safety-significant SIS setpoints. The documentation of the safety-significant HAW & LAW Evaporator Steam Coil High Pressure Interlock instrument loop uncertainty and interlock setpoint calculation was excellent. Further, use of the guidance contained in *ISA-RP67.04.02-2010, Methodologies for the Determination of Setpoints for Nuclear Safety Related Instrumentation* for developing, documenting, and justifying these calculations is a noteworthy practice.

A detailed review of an example of a draft SIS software simulator test procedure was performed to develop and provide feedback to the WSB Project design engineers on the adequacy of their approach for developing and approving similar software test plans. Although the reviewed *Installation and Operational Verification of Low Activity Waste Steam Valve Module Test Procedure* is not able to demonstrate all required SIFs due to simulator limitations, successful completion will provide a valid basis for integrating the software with the SIS hardware for further testing. Further, the SRNS and WSB Project requirements for safety-related software quality, WSB safety requirements specifications, and WSB SIS requirements specifications for software, in concert with planned hardware FAT, software module simulator testing, and integrated software/hardware start-up testing provide a robust set of processes for appropriately qualifying the SIS software for safety-significant service.

7.0 FOLLOW UP ITEMS

None

8.0 OPPORTUNITIES FOR IMPROVEMENT

This Independent Oversight review identified the following opportunities for improvement (OFIs). These potential enhancements are not intended to be prescriptive or mandatory. Rather, they are offered to the site to be reviewed and evaluated by the responsible line management organizations and accepted, rejected, or modified as appropriate, in accordance with site-specific program objectives and priorities.

OFI-1: Consider resolving the remaining 2011 OFIs listed in Appendix C to satisfy SIS component CGD requirements.

OFI-2: Consider clearly establishing and using the appropriate values for pressure transmitter reference accuracy and digital display reading accuracy in finalizing SIS instrument loop uncertainty calculations.

OFI-3: Consider revising the sequence of *Installation and Operational Verification of Low Activity Waste Steam Valve Module Test Procedure* steps associated with simulation of the software's response to pressing the SIS Reset pushbutton by forcing an input of "0" immediately following the input of "1".

Appendix A
Supplemental Information

Dates of Review
Onsite Review: April 23-26, 2012
Offsite Review: May 3-5, 2012

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Appendix B
Documents Reviewed

May 2011 WSB Electrical Configuration Control Assessment Report

G-TRT-F-00012-Rev 6 – Configuration Management Plan
NNP-WSB-2009-00003 Rev. 1 – Desktop Instructions
U-PSBCR-F-00003-Rev 1 – Revision of Preliminary Safety Basis Change Request

June/July 2011 WSB Commercial Grade Dedication Plans for the Safety Instrumented System

E-ESR-F-00042, Lambda Power Supplies – Safety Requirements Specification
E-ESR-F-00043, Push Button – Safety Requirements Specification
E-ESR-F-00044, Logic Solver – Safety Requirements Specification
E-ESR-F-00045, Diode Module – Safety Requirements Specification
E-ESR-F-00046, UPS – Safety Requirements Specification
E-ESR-F-00047, Fuses – Safety Requirements Specification
E-ESR-F-00048, Selector Switch – Safety Requirements Specification
E-ESR-F-00049, Annunciator – Safety Requirements Specification
E-ESR-F-00050, Breaker – Safety Requirements Specification
E-ESR-F-00051, Enclosures & Racks – Safety Requirements Specification
E-ESR-F-00052, Phoenix Relay – Safety Requirements Specification
E-ESR-F-00053, Terminals & Support – Safety Requirements Specification

Setpoint Calculation

ISA-RP67.04.02-2010, Methodologies for the Determination of Setpoints for Nuclear Safety Related Instrumentation
AC68798A Sheet 71, RTD Data Sheet
AC68798A Sheet 72, RTD Data Sheet
E-E4-F-9740, Annunciator Wiring
J-CLC-F-00365, Rev. B, Instrumentation Uncertainties Evaluation and Set Point Determination-HAW & LAW Evaporator Steam Coil High Pressure Interlock
J-CLC-F-00367, Rev. 0, Instrumentation Uncertainties Evaluation and Set Point Determination-ACVS DP Interlock
J-CLC-F -00368, Rev. 0, Instrumentation Uncertainties Evaluation and Set Point Determination-Corridor to Outside DP Interlocks
J-CLC-F-00369, Rev. 0, Instrumentation Uncertainties Evaluation and Set Point Determination-HAW PVV Fan Pressure Interlocks
J-CLC-F-00370, Rev. 0, Instrumentation Uncertainties Evaluation and Set Point Determination-LAW EVAP High Temp Interlock
J-CLC-F-00371, Rev. 0, Instrumentation Uncertainties Evaluation and Set Point Determination-HAW PVV Flow Alarms
J-DCF-F-01147, Rosemount Data Sheet DCF
J-JD-F-0469, Press Ind Data Sheet
J-JD-F-0544, Temp Xntr Data Sheet
J-JD-F-0602, Press XMTR Data Sheet
J-JD-F-00694, Pree Ind XMTR Data Sheet
J-JD-F-00714, Diff Press XMTR Data Sheet

M-M6-F-4119, HAW Evap P&ID
M-M6-F-4123, LAW Evap P&ID
M-M6-F-4178, Process Vessel Vent P&ID
M-M6-F-4179, ACVS Exhaust P&ID
QB00517K - Sheet 780, Mass Flow Transmitter & lnline Flow Elements - Product Data R1
QB00517K - Sheet 3434, Rosemount Temperature Transmitters, RTDs and Thermowells
QB00517K - Sheet 3931, Magnetrol - Flow Meter- IO&M Manual
QB00517K- Sheet 1188, Rosemount Model 3051 C - Hart Protocol - Product Data

SIS Software Design & Testing

Manual 1Q, Procedure 20-1, Rev-11, Software Quality Assurance
Manual E7, Procedure 5.01, Rev-2, Software Engineering and Control
Manual E7, Procedure 5.03, Rev-3, Software Quality Assurance Plan
Manual E7, Procedure 5.04, Rev-2, Software Project Management Plan (U)
Manual E7, Procedure 5.07, Rev-2, Evaluation of Existing and Acquired Software
Manual E7, Procedure 5.10, Rev-3, Software Requirements (U)
Manual E7, Procedure 5.20, Rev-3, Software Design and Implementation (U)
Manual E7, Procedure 5.40, Rev-2, Software Testing, Acceptance, and Turnover
B-SQP-F-00034, Rev-5a, WSB Software Quality Assurance Plan
B-SMP-F-00003, Rev. 4,WSB Software Project Management Plan
B-RS-F-00029, Rev-0, Safety Instrumented System Requirements Specification for Software
B-DD-F-00039, Rev-0, Safety Instrumented System Software Detailed Design
B-STP-F-00117, Rev-0, DRAFT, WSB SIS Software Test Plan
B-TPR-F-00119, Rev-0, Draft-3, Installation and Operational Verification of Low Activity Waste Steam Valve Module Test Procedure
B-TPR-F-00118, Revision 0, Draft 2, Installation and Operational Verification of HAW Steam Valve Module Test Procedure
J-J2-G-0626, Rev 2, Control Logic Diagram-Symbols & Legends
J-J2-F-3023, Rev-0, WSB Control logic Diagram, LAW Evaporator Steam Isolation Valve HV-1553
J-J2-F-3024, Rev-0, WSB Control logic Diagram, LAW Evaporator Steam Pressure Valve PV-1554
J-J2-F-3096, Rev-0, WSB Control logic Diagram, LAW Evaporator Steam Isolation Valve HV-1571
M-M6-F-4123, Rev-2, LAW Evaporator P&ID
M-M6-F-4119, HAW Evaporator P&ID

Appendix C
Remaining WSB SIS CGD Opportunities for Improvement

These OFIs relate to the remaining inadequacies in documented requirements for factory acceptance testing, receipt inspection, or site acceptance testing, the acceptable results of which are required for CGD to confirm component engineering specification documented critical characteristics have been met.

SIS – Terminals and Supporting Accessories

- Contrary to E-ESR-F-00053, Table 1, first verification requirement on page 9, E-ESR-F-00053, Attachment 1 and RICP# 11923 do not require verification of component "correct dimensions."
- Contrary to E-ESR-F-00053, Table 1, third verification on page 10, the Hardware Acceptance Test, Attachment 1, does not include verification of wire type and size in the cabinet versus the drawing. However, the WSB Project staff indicates the wire types and sizes were already verified during the SIS FAT and will be documented as such in the CGD Plan.
- E-ESR-F-00053, Attachment 1, step 8 and step 10 do not include a tolerance on the acceptable specification of measured resistance and dimensions, respectively. As currently documented, only an exact value is acceptable. It is recommended that engineering justified tolerances be developed and added for these measurements. The previously specified plus or minus 10% was not supported by E-ESR-F-00053, Section 9.0, "Critical Characteristics," or the PK9GTA Product Data Sheet.

SIS – Series 90A Annunciator and NOVA Horn

- E-ESR-F-00049, Section 9.0, "Critical Characteristics," does not indicate, and Attachment 1 does not test for, the desirable characteristics of whether an acknowledged alarm with a solidly illuminated panel will re-flash if the process sensor again senses an alarm condition.

SIS – Allen Bradley 3 Position Selector Switch (800T-J42A)

- E-ESR-F-00048, Attachment 1, Step 3 and Step 4 should be revised to also verify the contact that closes and the contact that remains open are maintained in those positions after releasing the switch.
- E-ESR-F-00048, Attachment 1, Step 4 should also be revised to verify the contact that closed and the contact that remained open in Step 3 are now maintained in the opposite positions after releasing the switch.

SIS – DELTAV SIS 1508 Logic Solver and Supporting Components

- E-ESR-F-00044, Attachment 1, does not specify the steps in input current to be utilized in verifying the ability of the analog input channels to read analog input signals, each within 2% of span accuracy.
- E-ESR-F-00044, page 33 of 54 has some unreadable text because the text overlaps existing text.

SIS – Lambda LZSA500-3 Power Supply

- E-ESR-F-00042, Attachment 1, Step 2 is inconsistent with the requirements of section 9, Critical Characteristics. Specifically, the required variation in output voltage is not accompanied by verification of no over-current or over-heating, and the inequality signs before the voltage limits are reversed in direction.

SIS – ABB Double Pole 15A Breaker (S202-K15)

- E-ESR-F-00050, Table 1, thermal trip specification on page 11 of 24 (10-60 seconds at 3x rated current) does not agree with the Section 9.0 thermal trip evaluation criteria (10-40 seconds as current slowly rises above 3x rated). The correct thermal trip specification for this breaker, based on its "K" tripping characteristic curve, is 10-40 seconds at 3 times rated current. Table 1 and Attachment 1, Step 7 should be revised to specify the 10-40 second acceptance criteria.
- E-ESR-F-00050, Attachment 1, Step 5 should be revised to read "Rapidly apply 8 to 12 times the rated current, and verify that the breaker trips in less than 3.5 milli-seconds (<3.5 ms) to be consistent with the published breaker specifications." Section 9, Critical Characteristics for an instantaneous trip, should also be revised to specify 2.5 to 3.5 milliseconds.

SIS –FERRAZ-SHAWMUT Fuses/Fuse Holders

- E-ESR-F-00047, Section 9.0, Table 1 and Attachment 1 do not assess the adequacy of insulation between the two ends of the fuse holder without an installed fuse.
- E-ESR-F-00047, Attachment 1, does not specify if the resistance between the fuse and fuse holder includes the resistance at both ends of the fuse. If not, there should be a place to record the resistance between fuse and fuse holder at both ends of each fuse/fuse holder combination.
- E-ESR-F-00047, Attachment 1, should be revised to remove the potential confusion between the notes stating "Test a minimum of four fuses from the lot of fuses received" and "Verification methods apply to a 100% sample of components."